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Notes on the Herpetology of Adams County, Iowa

By RICHARD B. LOOMIS

During the years of 1942 and 1943 the writer had numerous opportunities to collect amphibians and reptiles around Corning, Adams County, in southwestern Iowa. With the aid of Mr. Frank Bixler of Corning, sixty-seven specimens were collected and donated to the University of Nebraska State Museum at Lincoln.

Seven species of amphibians and thirteen species of reptiles are represented. Another species of amphibian, the small-mouthed salamander, *Ambystoma texanum* (Matthes), is known from Adams County, having been reported from 10 miles west of Corning by Reeve M. Bailey in 1943[1].

The species collected are reported below, the numbers referring to the Herpetological Collection of the University of Nebraska State Museum.

Ambystoma tigrinum tigrinum (Green)—A. 370-1. 5 miles north of Corning. These adult tiger salamanders were collected in May, 1943. Two adults were also found in Corning.

Bufo terrestris americanus Holbrook—A. 408. 5 miles north of Corning, May 29, 1942; A. 454-5. Corning, May 30, 1942. The american toad is very common.

Acris gryllus blanchardi Harper—A. 456-7. Corning, May 30, 1942; A. 458-9. 5 miles north of Corning, May 29, 1942. The cricket frog is common around permanent water.

Pseudacris nigrita triseriata (Wied)—The striped swamp frog is found early in the spring around Corning, inhabiting water-filled ditches and temporary pools.

Hyla versicolor versicolor Le Conte—A. 470. 5 miles north of Corning, May, 1942. The common tree toad is rarely seen in Adams County.

Rana catesbeiana Shaw—A. 447. 5 miles north of Corning, May 29, 1942. This bullfrog was collected in a small ox-bow pond.

Rana pipiens Schreber—A. 448-50. 5 miles north of Corning, May 29, 1942; A. 451-3. Corning, May 30, 1942. The leopard frog is common throughout the county.

Coluber constrictor flaviventris Say—The blue racer is very abundant, but none of our many specimens were preserved.

1. Bailey, R. M. 1943. Four species new to the Iowa herpetofauna, with notes on their natural histories. Iowa Acad. Sci. Vol. 50. 1943, pp. 347-352.

Elaphe vulpina vulpina (Baird and Girard)—573. 5 miles north of Corning, May, 1942. Only one adult fox snake was preserved, but a few other specimens were caught at the same locality.

Pituophis catenifer sayi (Schlegel)—The most common snake in Adams County is the bull snake. Two were encountered in courtship 6 miles southeast of Corning on May 26, 1943. The male had grasped the female just behind the head, and was rapidly undulating his body over her's, with his tail continually moving near her anus. The female seemed annoyed by the male's advances and attempted to crawl away. Twenty minutes elapsed before the observation was interrupted. Other bull snakes were collected in Corning and 5 miles north.

Lampropeltis triangulum syspila (Cope)—565. 7 miles west of Corning, August, 1942. DOR; 839. 5 miles north of Corning, May, 1942. The red milk snake is fairly common north of Corning. A large female measuring 32 inches laid eight eggs while in captivity.

Natrix grahamii (Baird and Girard)—A single specimen of Graham's water snake was collected in Corning on August 20, 1942, under a rock in a small stream.

Natrix sipedon sipedon (Linne)—568. Corning, August, 1942. This large common water snake was a gravid female containing thirty-nine fully developed young.

Storeria dekayi texana Trapido—571-2. 5 miles north of Corning, August, 1942. The little brown Dekay's snake was collected from under debris and logs.

Thamnophis radix (Baird and Girard)—The plains garter snake is common throughout the county.

Thamnophis sirtalis parietalis (Say)—The red-sided garter snake is abundant around the permanent streams and lakes, but is not found far from water.

Tropidoclonion lineatum (Hallowell)—569-70. 624. 5 miles north of Corning, June, 1942. Two small lined snakes were found DOR on a road just north of Corning, on May 29, 1942.

Sistrurus catenatus catenatus (Rafinesque)—1084-5. 6 miles southeast of Corning, May 26-7, 1943. Both of these massasauga rattlesnakes were killed in a semi-cultivated valley. This rattlesnake was formerly common in southern Adams County, but cultivation seems to have greatly reduced its numbers.

Chelydra serpentina serpentina (Linne)—The common snapping turtle is abundant around Corning.

Chrysemys bellii bellii (Gray)—The western painted turtle is very common in the ponds just south of Corning, and 5 miles north.

Among the probable members of the herpetofauna is *Bufo cognatus* Say, the Great Plains toad. Number A. 413, collected 1 mile east of Emerson, Montgomery County, is from the adjacent county to the west.

A big brown and yellow rattlesnake was reported to have formerly occurred in the timber of the county. It appears that the timber rattlesnake, *Crotalus horridus horridus* Linne, has become extinct in the county.

Reptiles at Branford, Connecticut

By LEO CHARLES FINNERAN

Branford is a township lying nine miles east of New Haven, Connecticut, on Long Island Sound. It is roughly bisected by the Branford River which drains into the Sound. Two bodies of water feeding the river are locally known as the Supply Pond and Ward's Mill Pond. These ponds have been formed by a dam on the river proper and on one of its tributaries. Both are surrounded by a close growth of pines. The northern portion of the town is farmland and hilly pine. The Sound and central section is residential.

The following field observations were made from the spring of 1940 to the fall of 1947. I have found, during this period, ten of the fifteen snakes found in Connecticut, and eight of the ten known turtles. Those not recorded from here, to date, are as follows:

Carphophis amoena amoena (Say)
Opheodrys aestivus (Linne)
Opheodrys vernalis vernalis (Harlan)
Storeria occipitomaculata (Storer)
Crotalus horridus horridus (Linne)
Kinosternon subrubrum subrubrum (Lacepede)
Clemmys muhlenbergii (Schoepff)

I know of a case where a specimen of *Crotalus horridus horridus* (Linne), taken from the northwestern portion of the state, was released here in 1944.

The expressions of abundance given below are relative and reflect the writer's experience. For example, I do not doubt that the ring neck snake is fairly common here. I simply have not been there when they were.

Diadophis punctatus edwardsii (Merrem). I did not find a single specimen until September 2, 1946, when a male measuring 32.5 cm. was found in the pine area off the Supply Pond. The snake was dead although showing no marks of violence or disease. It was lying exposed on a bed of pine needles.

Heterodon contortrix contortrix (Linne). This animal has been observed in strawberry patches and cornfields of the northern part of Branford. On October 21, 1943, a fine *'niger'* specimens was found DOR on the road circling the Supply Pond. It was headed away from an adjacent pine tract.

Coluber constrictor constrictor (Linne). This is a common snake. At Coon's Ledge, in the northern section of Branford, it is found a little earlier in the spring than the copperhead. I can readily agree with Wood's report (1944: p. 257) on the belligerence of this animal. A farmer in this section has constantly warned me away from Coon's Ledge during the spring, saying the snakes were breeding and would "chase you." This very thing happened. In 1943, a blacksnake followed me for approximately ten feet, and, in 1946, a male aggressively attacked me for a period of three minutes. There was ample opportunity for escape.

Another interesting observation is a method of escape observed three times at Coon's Ledge. The snake would scoot swiftly down the sharp, rock-covered incline until it came to a group of laurel. There it would climb into the branches and remain motionless.

On September 13, 1940, a five-foot, five-and-one-half-inch specimen was observed to swallow a *Thamnophis sirtalis sirtalis* (Linne) measuring twenty-one inches.

Elaphe obsoleta obsoleta (Say). This is one of the less common snakes. My largest specimen measured six feet one inch. They have been taken only in the northern section.

Lampropeltis triangulum triangulum (Lacepede). I have seen only immature milk snakes. They have been observed DOR in all parts of the township. The absence of adults is assumed to be due to nocturnal habits.

Natrix sipedon sipedon (Linne). A very common snake occurring along water bodies in all parts of the town. One female taken in early spring was found to contain a great mass of parasites (Nemathelminthes). Unfortunately they have not been identified as yet. These parasites had caused a prominent external bulge.

Storeria dekayi (Holbrook). A common snake. The largest hibernating den here is located in a built-up area over which a bridge has been constructed. This bridge crosses a railroad track. The bridge is in constant use and the adjacent locale is well populated. Still the den has been used annually during the period covered in this paper.

Thamnophis sauritus sauritus (Linne). It does not seem to be common. I have seen it in only one place, along a small grassy stream during the spring of each year.

Thamnophis sirtalis sirtalis (Linne). A common snake. One was found, covered with iron oxide, hibernating in a tin can. The can was barely covered with icy wet leaves.

Agkistrodon mokeson mokeson (Daudin). On September 1, 1947, three females were collected at Coon's Ledge. One of the females measuring thirty-one inches contained 12 embryos. The second measuring twenty-nine inches gave birth to ten young. The third measuring twenty-four inches gave birth to five young. The den from which these animals came is of interest. It is at the summit of a typical loose rock ledge. Cedars, pines, laurel and blueberry bushes are the predominant vegetation. During the period of this paper I have not failed to find a localized group of gravid females each year. The original area covered approximately five square feet.

The first year at various times from the end of July to September, there were groups of five to eleven in this area. On July 31, 1941, there were five in this area and on August 1, there were four more. In 1942, the groups in this area were larger, seven to nine, and on September 12 and 14, we obtained several young under a rock in the center of the 'maternal den' area. This rock is of interest for, on August 1, 1941, and September 23, 1943, newly born young numbering three and four were found. The

August 1, 1941 date appears rather early to me for I noted a pair mating on April 26 of that year. Last year (1946) the den moved approximately ten feet to a more shady, broken lighted area. On September 7, we found nine gravid females there. This year, the above-mentioned three were noted along with one other.

A general observation of interest is that as summer goes into August and early September, the copperhead is frequently found near a body of water. I have noted this in 1942, 1943, and 1946. Every one of the specimens caught in such a locale proved to be a male.

On September 21, 1947, a very cloudy day, we observed the largest specimen that I have seen from this area. It measured forty-nine inches. This copperhead was found in a cornfield about five hundred yards from Coon's Ledge.

Sternotherus odoratus (Latreille). On April 26, 1943, eight were taken in a shallow area of the Supply Pond. A pair of this series were discovered to be copulating palstron to plastron. The male was holding the female with all four claws. The temperature of the water was 22° C. The number of specimens in this spring aggregation area each year varies from eight to thirty and copulation frequently has been observed. In all other cases the position was dorsal ventral.

This turtle is fairly common along the dam region of both the Supply Pond and Ward's Mill Pond. I have found it in no other place.

Chelydra serpentina serpentina (Linne). A common, hardy species. I have seen it in the tidal influenced parts of the Branford River, and crawling along under the ice of a small pond in mid-winter.

On two occasions I have observed crows eating the eggs of the snapping turtle.

Clemmys guttata (Schneider). On March 21, 1943, a female (length 109 mm.) and male (length 104 mm.) were found to be copulating. The temperature was 19° C. On May 2, 1943, a female (length 90 mm.) and a male (length 100 mm.) were found to be mating. The water temperature was 19° C. Both of these pairs were observed in a fresh water swamp.

On May 2, 1943, I noted a female (length 109 mm.) and a male (length 104 mm.) making their way along the muddy bottom of a tidal influenced, brackish stream. The male was following the female. Every three or four feet, the female turned her head and seemed to look in the direction of the male. She turned four times as they moved approximately fifteen feet. At this point, the pair was disturbed by the writer's shadow. This observation seems to correlate directly with those reported by Noble (1945, p. 134). She states "—pairing is the result of search by the male, in which the bright yellow face of the female serves as a beacon." The temperature of the stream was 19° C.

The eggs of the spotted turtle hatch about September 20, in this region.

Clemmys insculpta (Le Conte). Most frequently taken in the spring of the year from woodland streams of the northern section. A newly

hatched, earth-incrusted turtlet was taken on September 3, 1946. No others were found at that time.

Emys blandingii (Holbrook). A male of this species was taken during the summer of 1940. This appears to be the first recent record for the Connecticut coast.

Terrapene carolina (Linne). This is a fairly common species in woodland areas. On June 5, 1942, a female was noted to lay five eggs.

In the spring of 1945, a female was taken and kept alone in an enclosure. During the following summer, she laid four eggs. Three of these were fertile. On September 29, 1946, she laid two eggs. One of these was fertile. This appears to be a case of delayed fertilization.

Malaclemys terrapin terrapin (Schoepff). A mature specimen was observed swimming among the Thousand Islands off Stony Creek. One specimen, taken from Milford, Connecticut, was accidentally released in Branford Harbor.

Chrysemys picta picta (Schneider). The following are records of egg laying at a sand pit immediately adjacent the Supply Pond.

June 3, 1942—7 eggs laid—hatched August 18, 1942.
June 3, 1942—6 eggs laid—hatched August 23, 1942.
June 5, 1942—5 eggs laid—hatched August 20, 1942.
June 25, 1942—5 eggs laid—hatched September 2, 1942.
June 23, 1946—7 eggs laid—all fertile.
June 28, 1946—6 eggs laid—one infertile.
June 28, 1946—5 eggs laid—all fertile.

On May 2, 1943, a female (length 142 mm.) and a male (length 124 mm.) were discovered in copulation. The water temperature was 20° C. The location was a shallow bog swamp.

On April 26, 1941, two newly emerged turtles were found in a sandy area approximately fifty feet from the water. On May 23, 1946, an immature specimen with a very small yolk sac was found in a cultivated field about one-half mile from water. These might be considered cases of wintering over.

Three supposed cases of intergradation between *picta* and *marginata* have been observed. A male taken in 1943 from the southern part of the town. An immature specimen from Ward's Mill Pond in 1946. A female, in 1947, from a marsh area. All three showed a slight alteration of carapace scutes, and there was a dark marking on the anterior anal and femoral shields of the plastron.

LITERATURE CITED

Noble, Ruth Crosby—1945. *The Nature of the Beast*, Doubleday, Doran & Co.

Woods, G. T. Blacksnake Attacks a Boy. Copeia, 1944, no. 4, p. 257.

2124 MARLBOROUGH, DETROIT 15, MICHIGAN

Hibernation of the Alligator in an Artificial Environment[1]

By ALBERT M. REESE

The following data have perhaps, little value, as the observations were made on only one or two 18 inch specimens; but they will be summarized for what they are worth.

The animals were kept in a 4x4x2 foot cage in the museum of the zoology department. The cage had a wooden floor and roof, with a plastered wall in the rear, with wire ends and a glass front. It was near a window that was kept open most of the time, but the direct sunlight never reached the inside of the cage. A shallow pan with about an inch of water was in the cage at all times, so that the animals could enter the water whenever they desired to do so.

Observations were taken at very irregular one-hour intervals, mostly from eight A.M. to six P.M., but often as late as eleven P.M. On three occasions one of the animals was taken to the writer's residence for some weeks, and placed in an open box with the pan of water, at the head of the writer's bed, so that observations could be taken, with a flashlight, at all hours of the night.

The observations continued through a period of two years and eight months, with a total of approximately 2550 observations.

Asleep or awake.

The number of times the animal was found asleep or awake was as follows: during the colder six months of the year there were 545 asleep observations to 650 awake observations; while the warmer six months there were only 240 asleep observations to 1001 observations on awake animals; that is to say, the animal in the summer slept less than one fifth of the time, perhaps less than five hours a day.

During the winter months, when the animal was asleep at nearly half of the observations, it slept so soundly that repeated, loud taps on the glass and heavy jarring of the floor failed to awaken. Also a bright, 5mm spot-light, made from a microscope tube and objective, when thrown on its eyelid for five minutes or more failed to cause the eye to open. But a small rag, saturated with ammonis, caused the animal to back away after only a few seconds, when the rag was held 2-5 mm. from his nose; tho in many cases the eyes remained closed. A tap on the end of the snout with a hard rod would cause the animals to back away, often without opening its eyes.

In water or in air.

The amount of time the animal spent in water and out of it was noted.

During the six colder months it was seen in the water 812 times to 414 times in the air, nearly twice as often in the water.

During the warmer months there were 734 water observations to 525 air obesrvations. Of course the variations in temperature in this indoor cage were slight, compared to what they would have been outdoors.

During the month of May, 1946, when the animal was under observation in the writer's bedroom, it was awake at 137 observations, and asleep at only 4. Perhaps the strange environment had something to do with its wakefulness.

The lowest temperature recorded, and only on one occasion, was 6 degrees Centrigrade, while the highest was thirty degrees C.

In 15 obseravtions where the temperature was 10 degrees or below, 11 were in the water and 4 in the air. In 92 observations where the temperature was 21 degrees or above, 49 were in water and 42 in the air.

The recent experiments by Colbert, Cowles and Bogert * show that "Alligators are affected much less severely by adverse conditions of cold for brief periods than they are by adverse conditions of heat." . . . In other words these animals can withstand a drop of some 20 degrees Centigrade below the optimun temperature, whereas a rise of but a few degrees above this temperature is sufficient to be fatal.

"For these reasons the reactions of the alligators to low temperatures are much less marked than are the reactions to heat . . . In short, the alligator is better able to withstand adverse low temperatures above freezing than adverse high temperatures, and presumably the same holds true for other Crocodilians."

Feeding habits.

A dealer once told the writer that he kept his alligators in a cold place during the winter so that they would not eat. He said that if they were kept in warm water and fed they were not healthy.

The writer has kept alligators without food for three or four months, during the winter season, but during the present observations they were offered and accepted food during every month of the year, but much more eagerly during the summer months. They seldom, if ever, "asked for" food during the winter months. By "asking for" food is meant that they opened their mouths and ran to the open door of the cage so actively that they sometimes fell out of the cage upon the floor below. They were fed on any kind of raw meat, chicken or fish viscera, an occasional dead mouse or grasshopper.

*Bull. Amer. Mus. Nat. Hist., Vol. 86, Article 7, 1946.

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[1] Read Dec. 29, 1947 at the meeting of the Herpetologists League in its joint session with the Ecological Society of America, A.A.A.S. meetiag, Chicago, Ill.

Territorial Behavior in Snakes and the So-Called Courtship Dance

By CHARLES H. LOWE, JR.

It is generally believed that territorial behavior does not occur among snakes although it is at the same time recognized in their close allies, the lizards. With regard to snakes, however, there is considerable evidence already in the literature to the contrary though at present much of it is hidden under the guise of a so-called "courtship dance."

Davis (1936) first described the "courtship dance" of crotalids, as observed by R. Marlin Perkins, among captive Mexican west coast rattlesnakes (*Crotalus basiliscus*) and water moccasins (*Agkistrodon piscivorous*). This seems to be the only record of such crotalid behavior prior to 1942. During 1942, Carr and Carr reported "dance" behavior in *A. picivorous,* observed in the field in Florida. In the same year, Lowe reported such behavior in recently captured *Crotalus atrox* in California during the fall, and in *C. ruber,* as observed in the field by J. Duell of San Diego, California. Recently, Gloyd (1947) has called attention to its presence in the copperhead (*Agkistrodon m. mokeson*) as observed in the field in Virginia, by J. Ackroyd of Moorestown, New Jersey, and in the prairie rattlesnake (*Crotalus v. viridis*) as observed in the field in Montana by the late L. B. Gallaher of Harlowton, Montana. Cyrus B. Perkins of the San Diego Zoological Society has observed this behavior in captive copperheads. Others have infrequently seen it in our pit-vipers. Thus it is known to occur in the three groups of North American crotalids, having been observed in all three, both in the field and in captivity. It has been seen in the spring and in the fall of the year and in all reports to date has been considered courtship or mating behavior. It is my purpose to point out that this activity is apparently not courtship nor mating behavior at all; it is, in all probability, territorial display (intraspecific fighting response) among these vertebrates lacking limbs. Territoriality among snakes is, as with other animal groups, a fundamental and widespread pattern of behavior, either inherited by them from probable saurian ancestry or a parallel development with that reptilian group.

When one critically studies the reports of such "dances" and notes exactly what was observed, it is found that they have the following fact (among others) in common: no copulation was definitely observed.[1] In short, as far as is known, the "dance" pattern is neither followed nor preceded by copulation or an attempt at copulation. Further, many competent observers on numerous occasions have witnessed the actual mating of crotalids and other snakes. In no instance has the "courtship dance" been observed to precede or to follow copulation. The view that the "dance" is fighting between two individuals of one sex, and not courtship involving opposite sexes, eliminates this heretofore unexplained

[1]The general statement by Davis (*op. cit.*) concerning the captive behavior observed by R. Marlin Perkins, that "dancing" crotalids copulated, is a case to the contrary. Unfortunately no details are presented.

inconsistency which has puzzled many herpetologists for years. Copulation and "dance" have so far been seen as separate, distinct, and mutually exclusive phenomena not occurring between the same pair of individuals.

For various reasons, observers have not always sexed the "dance" participants. In those cases where sex was *definitely* determined, the snakes were *males*. In no case have the members of a dancing pair been shown to be male and female. Failure to sex individuals and error in doing so have been factors contributing to the present misconception of the true nature of the behavior involved. In his report on the "dance" in crotalids, Lowe (*op. cit.*) stated that one pair of *Crotalus atrox* consisted of two males (hemipenes were definitely present in both), and another pair of a male and female (hemipenes in one, not found in the other). The case where two males were involved was considered an odd situation at that time. In the other instance, one was definitely a male and the other was considered a female. It is realized now that the method of sexing the one individual, the so-called female (a living individual), was inadequate for determining sex. I must confess that the attempt was made with a maximum of youthful enthusiasm and a minimum of good judgment. The sex of the individual in question must be considered as undetermined. With apparently less grounds for recording the sex of the individuals involved, Carr and Carr (*op. cit.*) state as a male and female the two moccasins they did not collect after observing the "dance" in the field. They were perhaps led to the old and unfounded conclusion that "dance" means courtship of male and female; therefore, the two individuals must be of opposite sex. Apparently such has been the reasoning that has led to reports in good faith which have perpetuated this unfounded conclusion, the most recent being that of Gloyd (*op. cit.*).

Thus far we observe the following facts: (1) Dancing pairs have never been seen to copulate. (2) Copulating pairs have never been observed to "dance." (3) Participants, when adequately checked for sex, have always been males. Another fact becomes apparent: There exists a fundamental difference between a true mating pattern exhibited by crotalids and other snakes, and a distinct territorial pattern exhibited by them. Both of these patterns are more or less stereotyped and seem to consistently follow the same basic sequence of events whatever species or genus of the group is observed. Mating has been observed both in the field and in captivity. Essentials of the mating pattern are the following: Participants remain relatively passive upon the ground, not raising the anterior portions of their bodies vertically above the surface. The male crawls over the female for some time until copulation takes place. Certain colubrid males have been observed to seize the females in their jaws for variable but usually short periods of time. This pattern involves a male and a female, its ultimate sequel normally being copulation. The territorial pattern (the so-called "courtship dance"), however, is distinctly different. Its general essentials follow: Participants do not remain passive upon the ground. They raise the anterior one third to possibly two thirds of their bodies vertically above the ground, face each other a few

inches apart with necks curved and heads generally held horizontally or slightly vertically, and sway their bodies slightly, keeping their eyes upon each other. Thrusts of the head and neck are usually made at one another; the snakes usually entwine their necks (nearly entire bodies in some) and may then "flop" to the ground. The entire procedure may be repeated several times. Such twisting and "flopping" is often severe and may discourage one of the participants from the bout. In some forms considerable forward movement of both may take place. This pattern involves, in so far as is accurately known, two males. It does not normally involve copulation, although conceivably should a female be involved, what may start as a territorial display might end in copulation. Such an interpretation might be placed on the behavior of male and female fox snakes (*Elaphe v. vulpina*) briefly observed in the field by Carpenter (1947). Territorial responses in some snakes may be involved, as in lizards, in sex recognition.

The prevailing interpretation (courtship) of the biological meaning of the "dance," which may, in my opinion, properly be termed a territorial fight, is partly due to the infrequency of its observation and the consequent paucity of reliable data concerning it. Two things have been instrumental in obscuring the significance of the "dance." First, herpetologists in general have only in recent years realized that territorial behavior exists commonly among lizards and many believe that as such it is, among reptiles, a peculiarity of the lizards and not to be found in the other groups. The second stumbling block has been certain of the statements and conclusions of Davis (*op. cit.*) in his well-known summary. Apparently these have strongly affected the thinking of many herpetologists even though he stated that his conclusions were tentative since they rested upon data that was inadequate for indicating more than probabilities. The reason for much misunderstanding dates to several early reports, the apparent errors of which have been accentuated by repetition with additional false conclusion resulting. Interpretation of certain observations by Millet (1909), Beadon (1910), Wall (1921), Prater (1933), Stemmler-Morath (1935), and others, upon which Davis rested much of his conclusion, has never been actually demonstrated, or "proven," to be correct. Briefly, it appears that the "Coluber type of [mating] behavior" of Davis, as opposed to the "Natrix type of mating behavior," is not mating or courtship behavior at all; that he is incorrect in stating that males do not fight among themselves during the breeding season, etc.

Perhaps one of the most critical reports cited by Davis (*op. cit.*), was that of Franke (1881), "who apparently was a careful observer." Franke stated clearly that the males of *Coronella austriaca* ". . . at pairing time exhibited much jealousy and not infrequently engaged in fighting, in which they bit each other." This was unemphasized by Davis, and perhaps logically so, for it failed to fit a "general picture" and as such was apparently a single exception. Unfortunately, the valuable report of McCann (1935) was not included in the summary by Davis. This is one of the earlier clear-cut cases of male fighting, involving the "Coluber

type of behavior." It is one of the infrequent cases where the reporter did not make assumptions but demonstrated the sexes of the individuals involved. McCann states:

"During the months of June and July this year, my neighbours, at Andheri [Envs. Bombay, India], sent me two couples of Dhamans or Rat-Snakes (*Zamenis mucosus*) [=*Ptyas mucosus*] which they had shot. The snakes when shot were entwined round one another like a twisted rope, which naturally suggested that they were *in copula*. Examination, by dissection, showed that in both cases the snakes were males. This goes to suggest that the respective couples must have been fighting at the time they were shot. There are many records of snakes seen in the manner described and in most cases, if not all, that attitude has been ascribed to copulation. However, as is well known, snakes usually exhibit no obvious external sexual differences and only a careful examination aided by dissection will reveal the sex definitely.

"The combatants in these two instances were of almost equal size. What the fights were over it is difficult to say; but, as the breeding season was over these snakes may have been fighting for territorial supremacy."

It is interesting that in 1935, McCann was aware of the probable nature and purpose of the behavior observed, as well as the essential reasons for the misinterpretation of most other observers, even to the present day.

Another illuminating report is that of Fleay (1937) on an Australian elapid, the black snake (*Pseudechis porphyriacus*). As his report is perhaps not well known to naturalists in this country, it bears quotation at some length.

"Early in September, 1936, I collected in the red gum (*Eucalyptus rostrata*) forest bordering the Murray River near Tocumwal, N.S.W., some very fine specimens of *Pseudechis porphyriacus*, the common black snake . . . it was not until the advent of the Tocumwal specimens . . . that truly spectacular revelations were made. Then it was proved beyond doubt that in the mating season there may be a very definite and exceedingly violent rivalry between the males of this species . . . On the morning of October 12, 1936, an air of excitement and irritability was noticeable for the first time among the black snakes. No sooner did one specimen come into accidental contact with another than both reptiles would shoot swiftly away to cover . . . As the day became warmer, two of the larger snakes approached one another and moved along side by side, with heads arched and raised about a foot from the ground. As they moved along their heads swayed slightly from side to side, and their mouths gaped open.

"Though for a long time this curious alignment of the reptiles appeared to be a preliminary to copulation, this was definitely disproved, for the pairing of a male and female is an entirely different and more passive proceeding. Akin to a fencing bout, the 'on guard' position, with curved necks and raised heads, lasted just as long as it took one of the rival males to gain the advantage by placing its arched head above that of the other. Having seized the opportunity, the aggressor then twisted its neck about that of its enemy, and continued the twist, with furious writhing movements, until its whole body was entwined about that of its rival. The latter, though at a disadvantage, retaliated in similar fashion to the best of its ability. The general effect was similar to that of a two-stranded rope.

"Writhing, hissing and struggling, with both reptiles exerting the greatest possible constriction on each other, and actually rolling slowly over and over *en masse*, the 'round,' if one may so term it, lasted for perhaps a minute. Then as if by mutual consent they suddenly disengaged completely, and separated, only to line up slowly, with gasping hisses, and repeat the whole 'on guard' position and bewildering twisting motions. And so many times on that first day and during those that followed, providing the weather was sufficiently warm for active movement, the two big snakes continued to struggle in terrific efforts to wear one another

down. Occasionally they glided slowly from one end of the 'pit' to the other with mouths gaping open, hissing and gasping, before one gained the coveted 'neck hold' and precipitated the twisting 'rope grip.' Not always did they fight with one another, for occasionally a different male was involved with one or the other of these deadly rivals. Smaller males were also observed in combat, and it was noteworthy that they appeared to struggle with snakes approximately their own size. However, the original large combatants persisted in their bitter feud. The scales on both dorsal and ventral surfaces had become frayed and worn painfully thin so that haemorrhages were visible along both bodies and a general reddish tint could be seen through the scales. So engrossed were the combatants that on several occasions they completely disregarded my presence and continued to struggle even when lifted from the ground!

"Doubtless in the wild during the pairing months the stronger male intimidates rivals and drives them away from his 'territory,' and in support of the fact that these battles are not mere 'stadium' events brought about by captive conditions I have several observations to stress.

"Firstly, during the two months of October and November, 1936, while rivals fought each other in the 'snake pit,' copulation also took place, being indulged in at times by the rival males with various females between competitive struggles. When acts of pairing ceased in November, so likewise did all inclination to fight, and peace reigned once more.

"Secondly, in the month of November, 1936, Mr. Jack Clark, a keen bushman residing at the interesting Moira Lakes (Victoria), reported to me, quite independently of events in the Zoological Gardens, that he had chanced on two large black snakes in a swamp. They were tightly entwined, rolling about and struggling so furiously that they ignored his presence. He watched them for five minutes and then killed both reptiles. Mistakenly, but quite naturally, he considered that they were pairing.

"Thirdly, I have observed bitter struggles occurring among other male reptiles, particularly *Tiliqua nigrolutea* (the southern blue-tongued lizard), during the mating months of October and November (in south Victoria).

"In the case of the main feud in the snake yard at the Zoo, following weeks of prolonged struggling, one of the rivals eventually received the worst of the prolonged encounters and with scales torn and bleeding and evidentally totally exhausted it retired for several days to rest its battered body. Previous to this respite the encounters had been more than usually bitter, and several observations were made of the rivals actually biting one another savagely.

"However, in view of the strong immunity of Australian snakes to their own venom, this was definitely a very futile proceeding and largely a display of temper.

"The actual mating process in *Pseudechis porphyriacus* is quite distinct from the furious 'rope-coil' competitive struggles of the male snakes. A male snake exhibits sexual excitement by quick nervous movements. The tongue flickers more rapidly than usual as the snake glides along in the keen alert fashion observed during the hunting of frogs. Occasionally the females are pursued for some distance. *Actual copulation occurs with the male lying on—but not coiled about—the female, and heads are not raised above the ground.*[1] Curious spasmodic local twitchings and jerkings of each part of the body, from head to tail, are observed, and these gradually attain a climax of excitement."

[1] Italics mine.

Fleay's description of elapid behavior parallels, in all its essentials, the behavior of many other snakes. Crotalids have not been observed to open their mouths, move along side by side entwining their bodies completely, etc. These, and others, are minor variations of the fundamental pattern that is present and they tend to vary somewhat in different groups of snakes. On the whole, the display of *Pseudechis porphyriacus* is more nearly like that of colubrids than of crotalids and viperids, as is to be expected on logical grounds.

Woodbury (1941) records fighting in male *Pituophis catenifer desertícola* as observed by Misses M. Berryman and L. Olson in the field at Great Salt Lake, Utah. They reported a pair of males in active combat near a passive female. When first observed, the males were bowing their necks and repeatedly striking at each other.

"The posterior parts of the [male] bodies were closely entwined like the strands of a rope, as if for copulation, but the anterior parts were free. During the quarter or half hour of watching, the larger of the two males, about 5½ feet long, appeared to be gradually constricting and crowding the smaller male out from his entwined position. The reaction of the smaller male to this crowding was to strike at the other's head, which recoiled when hit and immediately prepared a return strike. The female was entirely passive, evincing no interest or choice between the combatants, which occasionally rested between struggles.

"The snakes paid no attention when approached within 4 feet with the camera to take the picture; in fact they went on without showing concern of the human spectators until Mr. Barrie reached down and picked up the larger of the two males."

In this instance, as in several others, a female of the species was present. In general, the female is but one aspect of territory. Presence of the opposite sex is not requisite for elicitation of the territorial response.

In the majority of observations, territorial display in snakes has ensued with marked disregard for the persons observing. This, however, does not seem to be as often the case with mating behavior.

From the foregoing outline of observation, the following interpretation seems tenable. Like all conclusion drawn from data derived by observation, it can be stated only in terms of probability: The serpent "dance" as observed in certain colubrids, elapids, viperids and crotalids, is a fighting response elicited between males of the same species and may be termed a territorial fight. This behavior has been misinterpreted as courtship behavior. Two behavior patterns have been confused; the two are separate and observably distinct phenomena.

Detailed study of marked individuals in the field is highly desirable for better understanding of these phases of behavior. Such study awaits someone who has the enthusiasm and who will take the time needed to hurdle the difficulties of continuous field observation. Notwithstanding previous views to the contrary, territorial behavior does occur among snakes and has been observed both in the field and in captivity. In so far as I am aware, to the present time it has only been recognized and reported as such by McCann (1935) and Fleay (1937) who clarified the matter for a colubrid and elapid species respectively. For some reason their reports seem to have been overlooked or not recognized by herpetologists since then, a notable exception being Smith (1939).

Certain characteristic behavior of cobras indicates to me that the function of the hood mechanism of these snakes will, in all probability, eventually be shown to be involved in territorial display. Territorial behavior may eventually be found common to both sexes in some snake groups. With regard to snakes in general, several points related to the problem are in need of clarification. Future observation and experiment (eg. administration of sex hormone) is highly desirable, both in the field and

in the laboratory, to establish beyond reasonable doubt the true nature and evolutionary significance of the behavior involved.

Literature Cited

Beadon, C.
1910 A snake flirtation. Jour. Bombay Nat. Hist. Soc., 20: 228.
Carpenter, C. C.
1947 Copulation of the fox snake. Copeia, no. 4: 275.
Hist., Zool. Ser. 20 (22): 257-290.
Carr, A. F., Jr. and M. H. Carr
1942 Notes on the courtship of the cottonmouth moccasin. Proc. New England Zool. Club, 20: 1-6.
Davis, D. D.
1936 Courtship and mating behavior in snakes. Field Mus. Nat. Hist., Zool. Ser., 20 (22): 257-290.
Fleay, D.
1937 Black snakes in combat. Proc. Royal Zool. Soc. N. S. Wales, Aug.: 40-42.
Franke, Ad.
1881 Die Reptilien und Amphibien Deutschlands. Nach einigen Beobachtungen geschildert von Ad. Franke. Leipzig, Veit & Co.
Gloyd, H. K.
1947 Notes on the courtship and mating behavior of certain snakes. Chicago Acad. Sci., Nat. Hist. Misc., no. 12: 1-4.
Lowe, C. H. Jr.
1942 Notes on the mating of desert rattlesnakes. Copeia, no. 4: 261-262.
McCann, C.
1935 Male rat snakes (*Zamenis mucosus*) fighting. Jour. Bombay Nat. Hist. Soc., 38: 409.
Millet, G. P.
1909 A snake flirtation. Jour. Bombay Nat. Hist. Soc., 19: 758-759.
Prater, S. H.
1933 The social life of snakes. Jour. Bombay Nat. Hist. Soc., 36: 469-476.
Smith, M. A.
1939 The fauna of British India, Ceylon and Burma. Reptilia and Amphibia, vol. 3. London.
Stemmler-Morath, C.
1935 Beitrag zur Fortpflanzungsbiologie europaischer colubridae. Zool. Gart., (n.f.), 8: 38-41.
Wall, F.
1921 Ophidia taprobanica, or the snakes of Ceylon. Colombo, H. R. Cottle.
Woodbury, A. M.
1941 Copulation in gopher snakes. Copeia, no. 1: 54.

Effect of Venom of *Micruroides* Upon *Xantusia vigilis*

By CHARLES H. LOWE, JR., *U. of Cal., Los Angeles*

An adult male *Micruroides euryxanthus* (sv, 450 mm.) collected at Tucson, Arizona, was kept in the laboratory on a diet of live adult *Anniella p. pulchra.* The limbless lizards were offered at two-week intervals and were usually eaten by the coral snake during the first night. As small snakes are a natural food of *Micruroides,* the close approximation of *Anniella* in habitus and certain habits to small fossorial snakes may account for their ready acceptance as food. The coral snake molted at five-week intervals and remained in excellent condition at constant room temperature. It spent daylight hours resting or tunneling in sand and was usually moving on the surface at night.

The night of May 16, 1947, the coral snake was placed in a gallon jar with an adult male *Xantusia vigilis* (sv, 30 mm.). Within a few minutes the snake seized the lizard at the base of the tail. When thus bitten, the lizard immediately jumped and the snake simultaneously released its hold; the lizard's tail remained intact. The bite was not particularly vigorous, nor was it of more than one or two seconds' duration. After the bite (10:32:15 P.M.) and the jump by which it freed itself, the lizard remained motionless for a few seconds and then made rapid, "digging" movements with the front limbs directed against the sides of the glass jar. This attempt at escape lasted for approximately a minute. The following observations were made:

10:34:00 Slight paralysis of hind limbs apparent.
10:35:00 Removed lizard from jar for observation.
10:35:30 Hind limbs completely paralyzed; front limbs with slight paralysis.
10:35:45 Front limbs with nearly complete paralysis; undulatory movements of entire body.
10:36:30 All limbs completely paralyzed; righting response present. (Time elapsed since bite: 3 min. 15 sec.)
10:36:40 Righting ability present but subnormal (slow).
10:37:00 Righting ability present but difficult (very slow).
10:37:30 Righting ability lost; deep rapid breathing. (Time elapsed since bite: 4 min. 15 sec.)
10:38:00 Deep rapid breathing and twitching of tip of tail.
10:38:15 Breathing rate decreasing.
10:38:30 Breathing ceased; apparent death. (Time elapsed since bite: 5 min. 15 sec.)
10:39:15 Body opened, heart beating slowly; normal saline applied.
10:39:45 Last heartbeat. (Time elapsed since bite: 7 min. 30 sec.)

The bite occurred at the base of the lizard's tail. General body paralysis proceeded posterio-anteriorly. Cessation of breathing preceded cessation of heart beat. No edema was apparent at the site of the bite or elsewhere. Death appears to have resulted from injection of a venom with a basic neurotoxic effect. The coral snake showed no interest in *Xantusia.*

The Male Combat "Dance" of Some Crotalid Snakes

By CHARLES E. SHAW

Included in D. Dwight Davis' "Courtship and Mating Behavior in Snakes" (1936, Zool. Series, Field Mus. Nat. Hist., vol. XX, no. 22, pp. 267-268) and also in a recent paper by Dr. H. K. Gloyd entitled "Notes on the Courtship and Mating Behavior of Certain Snakes" (1947, Nat. Hist. Misc., no. 12, pp. 2-4) are references to and descriptions of what these authors have termed a "courtship dance" which has been observed in some crotalid snakes.

It is the purpose of the present paper to recall to attention the fact that this interesting behavior pattern is in reality *not* a courtship dance between opposite sexes but actually a display of combat between *two males*. As M. A. Smith (1943, The Fauna of British India, Reptilia & Amphibia, vol. III, Serpentes, p. 22) has pointed out, "The positions assumed for the purposes are different."

In neither of the recent descriptions given by Gloyd (l.c.) of the dance of *Agkistrodon m. mokeson* and *Crotalus v. viridis* were the participants suitably identified as to sex. Carr & Carr (1942, Notes on the Courtship of the Cottonmouth Moccasin, Proc. N. E. Zool. Club, vol. XX, pp. 1-6) assumed the partners to be male and female in a dance which these authors observed in the field. Their identification of the sexes is not satisfactory since the participants were not actually captured in order that the sex of each might be accurately determined. C. H. Lowe, Jr. (1942, Copeia, no. 4, pp. 261-262) noted two dances in *Crotalus atrox*. In one of these both participants are identified as males, while the copartners of the other dance are stated to be male and female. In the case of the latter dance of male and female, there has, no doubt, in view of our observations on captive snakes, been an error in the sex determination of the supposed female.

Possibly the mistaken assumption that the crotalid male combat dance is preliminary to courtship or immediately precedent to copulation of the assumed male and female participants stems from Davis' (l.c.) description of the dance based on observations by R. Marlin Perkins of *Agkistrodon piscivorus* and *Crotalus basiliscus*. Regarding the dance, Davis (l.c.) remarks under *A. piscivorus*, "This extraordinary behavior may continue for hours at a time, and is usually followed by copulation." Concerning *C. basiliscus* the same author notes that "The courtship of this snake is essentially the same as that of the water moccasin although it is neither so violent nor so prolonged. The male nudges the female and rubs the side of his head against her body during courtship, which is a feature that has not been noted in *Agkistrodon*." In view of the complete dissimilarity between the true courtship-behavior pattern of *Crotalus* (*vide* C. B. Perkins, 1943, Copeia, no. 2, p. 109) and the behavior pattern of the male combat dance, the above quoted remarks are difficult to reconcile. At the Reptile House of the San Diego Zoo 81 courtships or matings have been observed and recorded in the genera

Crotalus (10 species and subspecies, including *C. basiliscus* and *C. v. viridis*), *Sistrurus* (*S. c. catenatus*), and *Agkistrodon* (*A. p. piscivorus*). In *NONE* of these was the courtship-behavior pattern initiated by the dancing of the male and female, nor have male and female ever been observed to dance *at any time*. It is suggested, then, that the observations of R. M. Perkins on *A. piscivorus* as reported by Davis were not continuous and that the dance was actually combat between two males. Therefore the ensuing observed copulation may have been either a homosexual union or, more likely a normal mating, the female having been confused by the observer with a previously noted dancing male of similar size and markings. Although we at the San Diego Zoo have never witnessed a male combat dance in *A. piscivorus*, we have observed courtships and matings in this species. From our observations it is evident that the courtship pattern of *A. piscivorus* is essentially similar to that of *Crotalus* which has been observed many times as indicated above. The male moccasin makes nervous, jerky motions of the head and neck, continually nudging the female along her back and sides. Davis' (l.c.) remarks on *Crotalus basiliscus* clearly portray the actual courtship pattern displayed by the male.

An important and evidently overlooked difference between the courtship and combat-dance pattern lies in the degree of participation of the individuals concerned. Courtship involves extremely little or no overt response of the female to the male; she appears completely indifferent to the coaxings of her would-be mate. By contrast, however, the male combat dance involves vigorous performance on the part of both males, even though it shortly becomes obvious that one of them is definitely the aggressor (though not always the victor) during the entire dance.

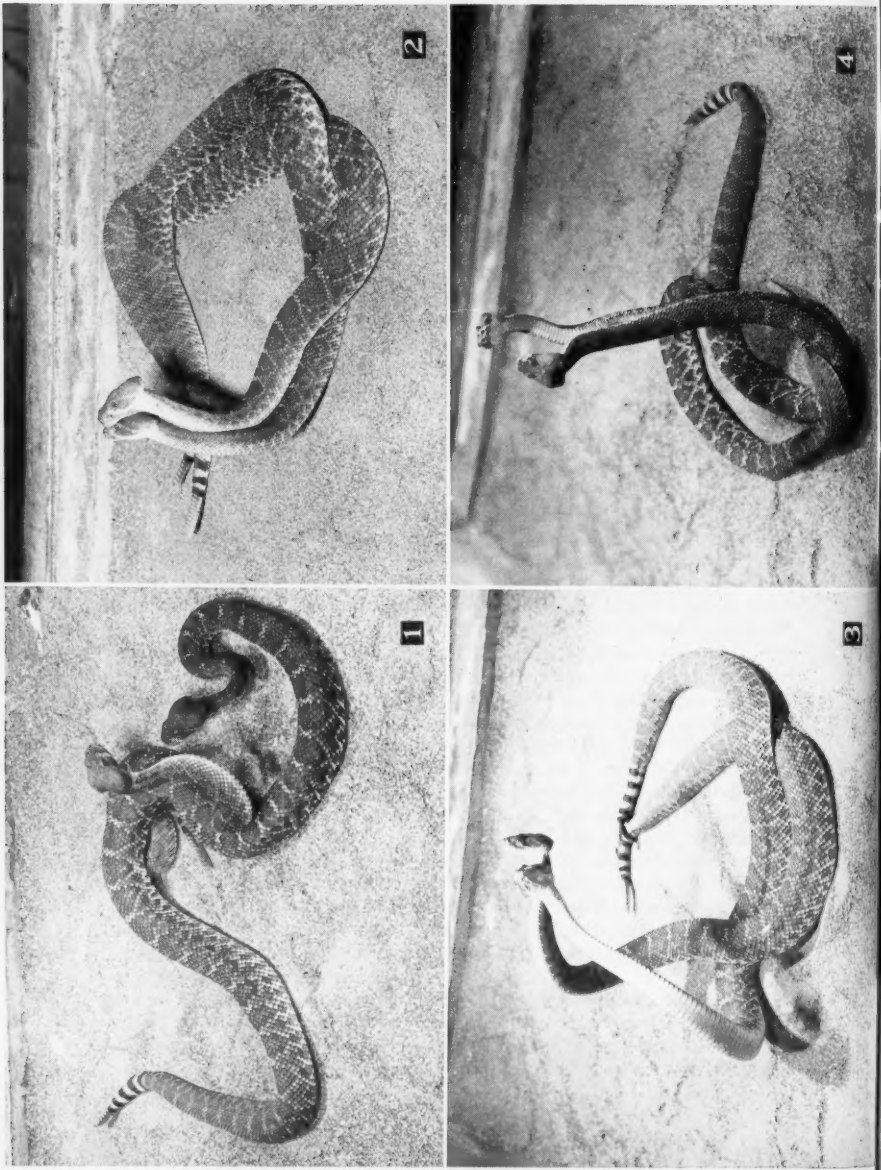
In view of the previously existing confusion of these two wholly distinct behavior patterns in certain crotalids, the one (courtship) a relatively commonplace manifestation, the other (the male combat dance) a much less frequently observed display among our captive specimens, the following remarks and observations may be of interest.

On Friday, December 19, 1947, an adult male *Crotalus ruber* was added to the collection at the Reptile House and placed in a display cage with two male captive-bred *Crotalus ruber*. These latter specimens were born at the Reptile House on August 14, 1941, and are now approximately four feet in length. To our knowledge neither of these captive-bred males had heretofore attempted to engage the other in a dance.

On Sunday, December 21, 1947, about 4 p.m. it was noticed that the two captive-bred males were acting in a peculiar manner. It soon was obvious that we were witnessing either the initiation (fig. 1, one starting position) of the combat dance or a re-commencement of it after a short recess by the engaged males. Both snakes then faced in the same direction, (fig. 2) one overlying the body of the other. Both were nervously alert with tongues flicking out frequently and heads and necks weaving rather slowly from side to side. The heads of both males were held upward at an angle of about 45°. The uppermost male had the anterior

portion of his body raised so that his head was held slightly behind and about three inches above that of the lower male whose head and neck were only raised an inch or two off the floor. The upper male, lying with his body draped over that of his partner, lowered his head until it touched the other's head, whereupon the lower male immediately elevated the anterior third of his body to a height of, say, 12-15 inches above the cage floor, the upper male rising simultaneously and maintaining his superior position. The raised portion of the lower male was considerably recurved so that only the top of his head contacted the ventral surface of the upper male (fig. 3 shows a similar position), both males apparently pushing (one forward, the other backward) against one another with a strong, even pressure. This position was maintained for a few seconds when the lower male lost purchase and slipped off the ventral surface of his opponent. There was then an attempt of the snakes to entwine their necks, both making lateral undulatory motions with the raised portions of their bodies while pressing against one another. Occasionally one participant was apparently caught off balance and pushed downward, but there was no evident attempt at this time by either male to throw the other forcefully to the floor.

After several minutes of sparring in this fashion, the uppermost male left his position overlying the body of the other male, crawled over to a forward corner of the cage and then nosed along the glass front until nearly opposite the other male which was lying flat on the floor and near the front center. At this approach, both snakes, about one foot apart and facing each other, assumed an elevated position again, the forward third of the body of each again being approximately 12-15 inches off the floor, the raised portions being strongly recurved and inclining at a steep angle, with heads held at about a 45° angle. There was very little flicking of tongues after the dance was well under way. Both snakes weaved rather unsteadily from side to side in this awkward-appearing position, until the raised and recurved portions of the bodies were gradually vertically straightened and then lowered toward one another until both snakes were touching scutes to scutes (fig. 4) for a short distance several inches behind the head. The heads were still being held at the 45° angle. At the moment of contact of the snakes, the entwining response was elicited but neither male seemed inclined to force the raised anterior portion of the other to the floor in a violent manner, rather there was a continual lateral undulation of the raised bodies, neck twining, and untwining, a constant sparring, with an evident forceful pushing of the snakes against one another. With the forward part of the body still raised one of the males turned away from his opponent and toward the window of the cage, pausing for a few moments in a raised position, motionless except for a peculiar rapid "rippling" muscular movement of the lower lateral surface of the neck about three of four inches behind the head. This combat dance was noted for approximately 15 minutes and its conclusion was not observed.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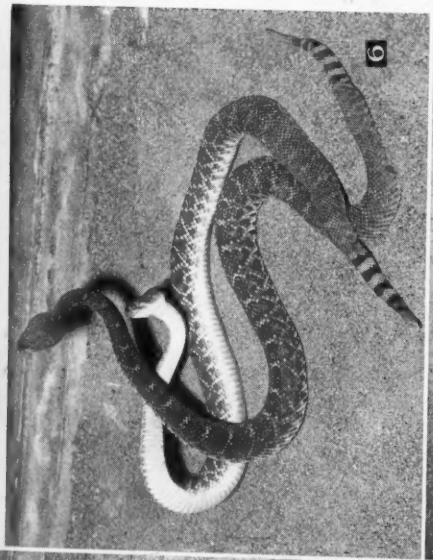
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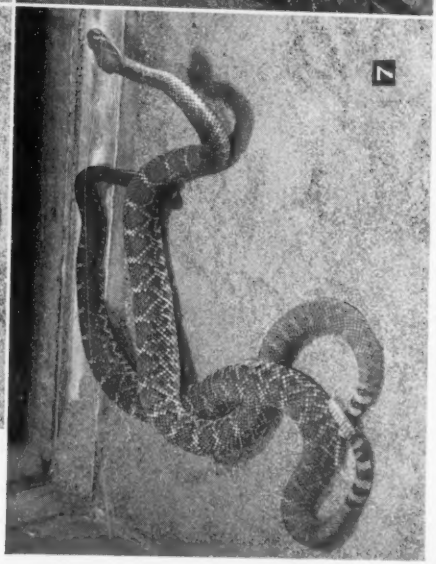
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The recently introduced male was completely indifferent to the activities of the two combatant captive-bred males.

On January 4, 1948, again about 4 p.m. (the time coincidence is indicative of our own activities, not necessarily those of the snakes) these two captive-bred male *ruber* were again noted while performing their combat dance. One of the snakes is definitely the aggressor while the other snake, although joining willingly, does not initiate the dance. On this occasion there was more of the "scutes to scutes" position (fig. 4) with the snakes facing each other, rather than an assumption of a superior position (fig. 2), behind and overlying his opponent, on the part of the aggressive male. Both snakes had the anterior one-third of the body raised about 12-15 inches off the floor surface of the cage. The heads were inclined upward as before, the snakes remaining nearly motionless in this position for several moments and then beginning what appeared to be an aimless swaying from side to side of the head and neck. Contact between the heads or raised portions of the bodies of the two generally brought about the neck-twining response with a slight sidewise or downward push of one snake by the other. Several times, with the anterior parts of their bodies erect, both snakes remained nearly motionless with their ventral surfaces in contact, to all appearances leaning upon each other for support. While in this position, the snakes were evidently firmly pressing against each other, until one or both lost purchase on the smooth contacting ventral scutes of the other and fell to the floor or nearly so (fig. 8). These contacts did not result in the neck twining as is customarily the case when the snakes contact each other.

Sudden and forceful downward or sidewise thrusts of one male by the other were not noted until the aggressor apparently succeeded in twining his own neck twice about that of the other male. Immediately this advantage was achieved there was usually a violent sidewise or downward throw of the opponent resulting from what appears to be a quick lateral undulatory whipping movement by the aggressive snake. This motion is actually so sudden and rapid that it is difficult to observe the exact method by which one snake throws the other. The opponent was usually thrown violently downward to the floor of the cage, falling either upon his side or upon his back (figs. 5 & 6). Occasionally this action was so powerful that the resultant "whack" of the snake's body on the floor could easily be heard although the observer was separated from the snake by a distance of about 4 feet and also the plate glass front of the cage. This dance was observed for about 25 minutes.

Subsequent to January 4, 1948, these two snakes were observed to perform the dance nearly every day. The pattern was essentially the same on all occasions. The same snake continued to be the aggressor in all dances. There also seemed to be more frequent violent throwing of one snake by the other than had been noted previously. Sometimes the thrown snake fell to a position in which either his head or neck was directly beneath the body of the other snake. In these instances the snake responsible for the fall appeared to take advantage of the fallen male by firmly

holding the latter's head or neck to the floor (fig. 7). The fallen male invariably experienced considerable difficulty in extricating himself from this position. The victorious male, however, was never observed to follow up his success by inflicting any sort of punishment upon the fallen male such as attempting to bite him.

During all dances witnessed, the males did not maintain a stationary position at all times, but frequently shifted positions over the floor.

The persistent sparring of the raised snakes, that is, the continuous twining of necks, seems to be a sort of maneuvering for an advantageous position from which one snake may forcefully throw his opponent. Whether or not it is the aggressive snake which continually seeks the advantage is not known, for in the confusion of heads, necks and motions simultaneous observation of both snakes is impossible. Evidently the snake in the disadvantageous position may sense his vulnerability and disengage himself before he can be thrown, for occasionally one snake commences to throw his opponent only to have the intended victim wriggle out of his predicament. This results in the would-be thrower throwing himself almost to the floor. At any rate, the combatants persist with these sparring motions until one (almost always the aggressor) either by accident or design succeeds in getting a double loop of his own neck around that of his opponent with the resultant violent sidewise or downward throw of the latter.

Our observations seem to indicate that visual cues alone are the means by which one snake responds to the challenge of the other to dance. During a recess in the dance when both snakes are lying in contact, but neither aroused to the fighting position with body raised, the movements of the one snake over the other do not seem to arouse the latter to raise his body and prepare for combat. However, the response is immediate the moment one snake, while holding his body in the raised fighting position, moves into the visual range of the other.

On January 14, 1948, the aggressive member of the dancing pair of *C. ruber* was noted courting the larger male *C. ruber* which had been introduced into the cage on December 19, 1947. While courting, the aggressor was continually nudging the new snake in typical courting fashion. At this time the posterior portion of the aggressor's body was overlying the body of the male with whom he had previously danced. The aggressor was sliding the posterior part of his body and tail down the rear part of the body and onto the tail of his erstwhile opponent, attempting to curl his tail beneath that of this male. This confusion of cagemates by the head and tail ends of a courting male often results when more than two snakes are confined together. Then the aggressor suddenly everted his right hemipenis for a few seconds, this act taking place while he continued his nudging of the newly introduced male. Later, while still courting the new male, the aggressor was approached by his former dancing opponent who came toward him with body reared high off the floor in an apparent challenge to combat. This was the only observed instance in which the normally non-aggressive snake attempted

to initiate the dance. The invitation was refused by the aggressor who was evidently too engrossed with his courting of the new male. For two or three days subsequent to January 14, the aggressor made frequent and persistent courting overtures toward the new male who showed apparent fear, coiling tightly and usually hiding his head within the center of the coil. Only once prior to this time had the new male been involved with either of the captive-bred males. On that occasion, about a week and a half after the introduction of the third male into the cage, the aggressive male of the captive-bred pair moved toward the new male, the former with body raised well off the cage floor in combat position. This appeared to be a challenge to the new male to dance and was promptly refused, the new male fleeing from the challenger, crossing the cage floor with his tail lashing wildly from side to side (but not rattling) in evident distaste of these proceedings.

The dancing of the two male *C. ruber* first commenced on the 21st of December and has continued almost daily to the time of this writing (January 31, 1948), excepting the period from January 21 to January 26, when the male introduced on the 19th of December was removed from the cage together with the non-aggressive member of the dancing pair. A female *C. ruber* was then introduced into the cage containing the aggressive male in the hope that he would copulate with her. This male has courted her, but to our knowledge no mating has yet taken place. On January 26, the non-aggressive male of the dancing captive-bred pair was returned to the cage containing the male and female, and on January 28, was noted dancing again with his former opponent. The non-aggressive male has seldom courted the female which has been allowed to remain in the cage, but she has been frequently and vigorously courted by the aggressive male.

Interesting though the male combat dance is, the cause of this behavior is not apparent. The dance described above between two previously non-dancing *C. ruber* is even more difficult to understand. The courting of the recently introduced male by the aggressive captive-bred male suggests that the customary cues for sex recognition failed and that the aggressive male may have mistaken the new male for a female. This assumption suggests that the dance is one of rivalry between two males for a mate. However, the paucity of field records of this behavior even during the breeding season would seem to refute this possible explanation. Gloyd (l.c.) notes that A. M. Jackley "who has observed many mating pairs of this species in South Dakota, has told me that he has never witnessed it." Mr. Jackley has probably had more field experience with *Crotalus v. viridis* than any other person.

At the Zoo we have witnessed the male combat dance in *Crotalus v. viridis* and also in *Agkistrodon m. laticinctus*. In the case of *viridis*, three snakes, all adult males, were confined in the same cage for a period of more than 6 years prior to the commencement of any observed dancing by two of them in 1943. No females were present in the cage at any time. The dance always involved the same two males, the third male, to

our knowledge, never taking part. The behavior pattern of the male *viridis* was the same as that exhibited by the dancing males of *C. ruber* described above.

The combat dance of *Agkistrodon m. laticinctus* is similar to that of *Crotalus* but differs quite markedly, insofar as our observations are concerned, in that one of the males acts as though he were afraid of being bitten on the head. Gloyd (l.c.) quoting an instance of a dance in *A. m. mokeson* relates "On three distinct occasions one of the snakes broke the rhythm of the dance by darting its head rapidly at the other." These observations agree essentially with our own on *A. m. laticinctus*. We have noted, however, that the smaller snake always ducks and dodges the head thrusts of the aggressor, in what seems to our eyes to be a fear of being bitten on the head, although the aggressor never attempts to bite the other snake. These snakes also seem to be more tensely alert during the dance, and the neck-twining motions much more hurried, contrasting with the comparative leisurely motions observed in *Crotalus*.

The splendid photographs of the dancing *Crotalus ruber* were part of a series taken by Mr. G. E. Kirkpatrick of the Zoo staff.

ZOOLOGICAL SOCIETY OF SAN DIEGO, SAN DIEGO 12, CALIF.

A Note on the Food Habits of *Heloderma Suspectum* Cope

By CHARLES E. SHAW

Van Denburgh (1922, Occas. Papers Cal. Acad. Sci., 10: 475) lists bird's eggs, reptile eggs, and young rodents as natural food items of gila monsters, but some recent authors reporting the food habits of the species apparently have overlooked his inclusion of rodents and reptile eggs in the diet. A recent examination of 15 *H. suspectum* disclosed only 2 with food remains in the stomach. One of these, an adult, LMK 27175, from 7 mi. N.W. Owlhead, Pinal Co., Arizona, contained a very young round-tailed ground squirrel, *Citellus tereticaudus*, the unruptured leathery shells only, of 9 reptile eggs (whether lizard or snake is unknown), and the fragments of a blossom which was probably accidentally ingested. The stomach of the second specimen, also an adult, SDSNH 17875, from Gray's Ranch, Organ Pipe Cactus Nat'l. Monument, Pima Co., Arizona, contained only the back feet plus a mass of hair of an apparently half-grown specimen of the same species of round-tailed ground squirrel. Mr. L. M. Huey, Curator of birds and mammals at the Natural History Museum, San Diego, has kindly identified the rodent remains. In connection with the captive food habits of this species, it may be of interest to report that Mr. C. B. Perkins once had a gila monster eat an adult *Crotaphytus c. baileyi*.

ZOOLOGICAL SOCIETY OF SAN DIEGO, SAN DIEGO 12, CALIFORNIA.

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Mr. George Toland, Salina High School, Salina, Kan.
Mr. Gilbert Turner, Box 104, Largo, Fla.

* * *

Mr. Maeder wishes to exchange live reptiles.

Changes of Address

Mr. Wm. G. Degenhardt, 75-21 67th Rd., Middle Village, L.I., N.Y.
Mr. Geo. S. Fichter, Carolina Inn Apts., Chapel Hill, N.C.
Mr. R. C. MacEwan, 915 Euclid Ave., Beaumont, Tex.
Mr. Robert C. Pendleton, Weber College, Ogden, Utah.
Mr. H. L. Rosenthal, Rutgers U., New Brunswick, N.J.

Election of Officers

In accordance with Article 3 of our Constitution a list of nominees was selected by our President and ballots were mailed to all members. The unopened ballots were received by Messrs. Perkins and Shaw who kindly tabulated them. The results were that Dr. Hobart M. Smith was elected President and Dr. A. H. Wright was elected Vice-President.

Observations on *Naja haje* (Linnaeus) Feigning Death

By WESLEY H. DICKINSON

I opened a cage one morning and noticed an Egyptian cobra that appeared to be dead. I removed it and noted that the tail would hook around an object when the body was lifted. I took the cobra with me to a friend's house where I was to spend the afternoon, thinking that if I placed it in the sun it might come to life. The snake's mouth hung open and it lay on its back with an unnatural stiffness. I handled and watched it for an hour without detecting any breathing, but the trachea opened slightly and irregularly. A slight evidence of life was seen from time to time so I replaced the snake in its box and placed the wire cover over it.

After ten minutes absence I found the cover off and the snake gone. After prolonged search the snake was found entering a hole in a wall. The snake was active and agile. I believe that this demonstration was similar to the action of *Heterodon,* except that the cobra would not turn venter up if righted as is the case with *Heterodon.*

While placing the snake in its box I felt it go limp and apparently dead. Five minutes later it lifted the cover and started to escape, but it saw me approaching and "froze." It made no attempt to bite, but clamped down upon a stick which was placed in its mouth. It immediately released the stick and made no further move.

I then placed it upon its back on the cement walk. After a few minutes it righted itself and started to crawl, but upon being touched, again feigned death. This experiment was repeated several times.

I fail to see the reason for this action in the case of a poisonous snake. I presume that a cobra will lose this trait after becoming accustomed to capivity as is the case with Heterodon.

LONG BEACH ZOOL. SOC., LONG BEACH, CALIFORNIA

An Additional Record of *Graptemys p. pseudogeographica* (Gray), from Nebraska

By RICHARD B. LOOMIS *and* J. KNOX JONES, JR.

On February 17, 1947, a false map turtle was collected in the Missouri River valley at Crystal Lake, 2 mi. north of Dakota City, Dakota County, northeastern Nebraska by Walter Kiener. The abundance of aquatic vegetation in this ox bow lake affords an excellent habitat for *Graptemys pseudogeographica pseudogeographica* and the very abundant *Chrysemys picta bellii.*

Hudson (1942) reported the false map turtle from Nebraska from the Platte River, Hall County, in East central Nebraska. Over, (1923) reports the false map turtle from southeastern South Dakota without giving any definite statement as to the exact locality or reference to any specimens in the collection. This specimen confirms Over's report and is substantiated by a skeleton, UN 1299 (Herpetological Collection) in the collection of the University of Nebraska State Museum.

NEBRASKA STATE MUSEUM, LINCOLN, NEBRASKA

Natrix Cyclopion cyclopion in Texas

By JOHN E. WERLER

Since the occurrence of *Natrix cyclopion cyclopion* in Texas is based on only a group of twenty specimens from Black Bayou, Victoria County (C. C. Goff, Occ. Papers Mus. Zool., Univ. Mich., 1936, pp 5 & 7) it may be of interest to record several additional localities in the state where specimens of this snake were taken.

I collected four *Natrix cyclopion cyclopion* in the coastal region of southeast Texas: two of these were found in company with *Natrix sipedon clarkii* at Gilchrist, Galveston County, along a roadside ditch which empties into brackish East Bay, July 15, 1946. Two others were collected July 25, 1946, on the ocean highway, twelve miles northeast of High Island, Jefferson County. The four specimens show the following scale characters:

Gilchrist, Galveston County: AMNH 67626, male, OAL 735 mm., tail 174 mm., scale rows 27-27-21, ventrals 142, caudals 72. AMNH 67627, female, OAL 722 mm., tail 167 mm., scale rows 27-27-21, ventrals 140, caudals 67.

Twelve miles northeast of High Island, Jefferson County: AMNH 67891, female, OAL 660 mm., tail 145 mm., scale rows 27-27-21, ventrals 144, caudals 64. AMNH 67892, male, OAL 626 mm., tail 150 mm., scale rows 27-27-19, ventrals 142, caudals 70.

In all four snakes, all but the extreme anterior portion of ventrum is marked with numerous yellow or white semi-circles on a dark background.

SAN ANTONIO ZOOLOGICAL SOCIETY

Use of Scent Glands by Prenatal *Sternotherus Minor*

By WILFRED T. NEILL

On August 12, 1947, I found two turtle eggs that had been unearthed by a plow on a hillside overlooking a lake near Louisville, Jefferson County, Georgia. When broken open, one of the eggs disclosed a young *Sternotherus minor,* well developed, but with considerable yolk material remaining. The little turtle was capable only of the feeblest movements. When handled, it voided the contents of its scent glands, producing the vile odor that has earned the species its local name of "Stinking-Jim." The second egg also contained a little *S. minor* that reacted in similar fashion. It is interesting to note that the scent glands, and a behavior pattern involving their use, are well developed at a time in embryonic life when most muscular reactions are lacking. One wonders how effective the scent glands of these and other reptiles may be in discouraging the attacks of predators.

DEPARTMENT OF BIOLOGY, AUGUSTA JUNIOR COLLEGE, AUGUSTA, GEORGIA

A Large Litter of *Thamnophis s. Sirtalis*

By ROBERT H. MATTLIN

On the morning of August 23, 1947, a large specimen of *Thamnophis s. sirtalis,* in the collection of the Cleveland Zoo, gave birth to 51 living young, one of which was accidentally killed while the brood was being removed from the cage, and 13 unfertile ova. The unfertile eggs averaged about 13 mm. in diameter and were of the consistency of heavy, viscous grease. The female, 96 cm. in length, was collected along the Lake Erie Shore on the outskirts of Cleveland by a fisherman who brought it to the Zoo. Detailed collecting data was not obtained.

While the number of young is not exceptional for sirtalis, it is certainly well above average, although it is entirely possible that this species may produce as many as 80 in a single litter. Conant (1938, 107) mentions Ohio specimens giving birth to litters of 14, 16, 22, 27 and 30 on dates ranging from July 3 to August 1, inclusive. Ditmars (1936, 152) records two litters of 11 and one litter each of 8, 16, 28, 31 and 51 for New York specimens, and one litter of 27 for a Florida specimen. Birth dates for the above ranged from August 2 up to and including September 5. Ditmars (1943, 56) in his discussion of sirtalis states "The young are born alive . . . from one to six dozen in a litter, and the higher numbers are in the majority." Conant (loc. cit) states "A female 37 inches in length collected . . . July 7, 1931, contained 38 embryos and another 44 inches in length collected . . . June 28, 1931, contained 33 embryos." Both of the above-mentioned specimens were collected in Ohio.

Ten specimens of the present litter were picked at random to be weighed and measured. The maximum and minimum weights were 2.5 gms. and 2 gms. respectively with an average of 2.14 gms. Length varied from 17.9 cm. to 19.5 cm. with an average of 18.72 cms. The total lengths of the female and young cited above are probably exaggerated since all measurements were taken on living specimens, and the tendency is to stretch live snakes while this is accomplished.

Forty-seven of the young snakes were marked and released in a swampy area near the Cleveland Zoo where snakes of this species are quite common. It is hoped that some of the marked specimens will be collected in the future so growth under natural conditions may be recorded. The remaining three specimens were kept so that the growth of the captives can be checked against the growth of the wild specimens should any be recovered.

Literature Consulted

Conant, Roger
1938 The Reptiles of Ohio, American Midland Naturalist, Vol. 20: pp. 1-200, pls. 172-197.

Ditmars, Raymond L.
1936 The Reptiles of North America, Doubleday Doran, ppi-xvi + 1-476, pls. 1-135.
1943 A Field Guide to North American Snakes, Doubleday Doran, ppi-xii + 1-305, pls. 1-48.

Notes on Two Broods of Young of the European Slow "Worm"

By ROBERT H. MATTLIN

On July 25, 1947, twenty specimens of the European Legless Lizard *Anguis fragilis*, commonly called the Slow Worm or Blind Worm, were received at the Cleveland Zoo. At 9:30 A.M. on August 13, ten newly born specimens were discovered in the cage. At the time it was not ascertained whether one or more females had given birth, but subsequent evidence leads to the belief that only one female was responsible for the litter.

Immediately after the discovery of the young, all of the adults were carefully examined and one was found to be a gravid female. This specimen was isolated at once and placed in quarters where she could be carefully watched.

At 7:45 A.M., on August 17, seven young were found actively exploring this female's cage and three more were trying to struggle free of the amniotic sac. When next examined at 9 A.M., two of the young had escaped from the amnion and the third had approximately the forward one-third of its body free. Eighteen minutes later this specimen wriggled completely free and immediately started to crawl wildly about the cage in the same manner as the others.

This brood of ten led to the belief that the August 13 litter were the offspring of a single female, but such may not be the case.

The last female to produce young greedily swallowed an earthworm at approximately 10 A.M., about two hours and fifteen minutes after having given birth. On August 15, an earthworm very nearly the same size of the baby lizards was placed in the cage containing the first litter of young. It was grasped immediately by one of the tiny specimens which tried in vain to swallow it. The worm was removed, chopped into small pieces and returned to the cage. Several of the small lizards ate.

Coloration of the young is as follows: pearly, greenish grey dorsally, jet black ventrally and ventrolaterally with faint greyish stripes from gular region to vent on ventral surface. Under surface of tail, solid black. Chin, gular region, and side of head to a point level with the eye and nasal opening, black, but heavily sprinkled with grey. A faint black thread-like median dorsal line starting as an irregular black blotch situated at the suture of the parietal head plates extends to the tip of the tail in one specimen. In another, the line extends to the base of the tail, where it becomes obscure and disappears. In all of the other specimens, the line extends to about half the length of the tail.

Three specimens from each of the two broods were preserved.

All twenty of the two litters of young were weighed. Of the August 13 litter, four specimens weighed .50 gms and six weighed .75 gms. All specimens of the August 17 litter weighed .50 gms.

To date, September 23, 1947, all fourteen of the young are thriving on a diet of chopped earthworms.

CLEVELAND ZOOLOGICAL PARK, OHIO

Ladybird Beetles in Sagebrush Swift Stomachs

By GEORGE F. KNOWLTON

The belief sometimes is heard that ladybird beetles are protectively colored; therefore, they rarely are eaten by insectivorous vertebrates. After hearing this belief expressed during 1939, the food records of 433 *Sceloporus graciosus graciosus* (B.-G.) were examined. These specimens had been collected throughout Utah. These data showed that 37 of the stomachs examined contained a total of 59 ladybirds, still in recognizable condition.

Dr. G. F. Knowlton

Knowlton, Maddock and Wood (1946 Journal Econ. Entomology, 39: 382-383) summarized the data on recognizable insect food found in examining 2,191 sagebrush swift stomachs, collected throughout Utah over a period of 15 years. These workers recorded a total of 221 recognized Coccinellidae ladybird beetles, of which 52 were larvae. This compares with 273 carabid beetles, 38 click beetles, 61 darkling beetles, 109 scarabaeid beetles, 239 leafbeetles, and 122 weevils. From these figures, the writer would conclude that the sagebrush swifts had ingested ladybird beetles with approximately the same readiness as it took other beetles of similar size and abundance. Having a particularly high regard for ladybird beetles and an interest in their predacious feeding on aphids and similar small insects, the writer regrets that this data apparently does not insure ladybirds greater safety. However, the large number of injurious insects contained in the lizard stomachs more than made up for the beneficial insects eaten.

Collecting lizards: Lizards collected by the writer and his assistants for food habits studies in Utah have practically all been taken by means of an ordinary .22 rifle or pistol, using long or long-rifle shot shells. The rifling has not been bored from any of these guns. The two rifles most commonly in use have also been used for shooting ordinary cartridges.

UTAH STATE AGRICULTURAL COLLEGE, LOGAN, UTAH

Some Insect Food of *Sceloporus poinsettii* B. & G.

By GEORGE F. KNOWLTON

Major Chapman Grant recently sent me the preserved stomachs of four red scaly lizards, *Sceloporus poinsettii* Baird and Girard, collected in the Hueco Mountains of Texas, at approximately 11 a.m. on October 16, 1947. A microscopic examination of the stomach contents revealed this species to be definitely insectivorous, with a tendency to feed on medium to fairly large insects. The first two stomachs examined each contained the remains of a large preying mantid, together with weevils and other insect material.

Total recognizable insects contained in the four moderately well-filled stomachs consisted of: 4 Orthoptera, 1 being a large slender grasshopper and 2 large mantids; 5 Isoptera or termites in one stomach; 2 Odonata, damselflies; 1 Hemiptera, a pentatomid bug; 44 Coleoptera, including 22 medium to large weevils which were the most common insect material found and which were present in all stomachs, 3 darkling beetles (one a *Discodemus reticulatus* Say), 2 buprestid wood-boring beetles (*Acmaeodera auritincta* Fall, Det. J. N. Knull), 1 staphylinid, 1 sylphid, 1 dermestid, and 1 scarabaeid; 8 Lepidoptera, 4 being caterpillars and 4 adult moths, one moth being very large with its abdomen plumped out with many large yellowish-orange eggs; 2 adult Diptera; 34 Hymenoptera, 30 of which were ants, several being harvester ants. In addition, 2 spiders were recognized, one being very large and hairy—probably it was a tarantula. Nine parasitic roundworms also were present, only one of the stomachs being free of these parasitic worms. Only one small plant fragment was present. This doubtless had been ingested by accident.

UTAH AGRICULTURAL EXPERIMENT STATION,
LOGAN, UTAH

A Cestode Infestation in Typhlotriton

By PHILIP W. SMITH

During a study of the food habits of cave salamanders from a small cave near Waynesville, Missouri, certain larval *Typhlotriton spelaeus* Stejneger were found to be heavily infested with cestodes. Analysis of the plankton samples taken from pools within the cave revealed four proglottids which might have been passed with the feces.

Nine of the thirty-one larval salamanders examined were found to contain parasites. No cestodes were found in the adults. Each of the infected larvae, which ranged from 81 to 119 mm. in length, contained from one to six tapeworms.

Specimens of the tapeworms were sent to Dr. A. C. Walton of Knox College, Galesburg, Illinois. Concerning their taxonomic status and previously known hosts, he states: "They seem to be a protocephalid of the genus *Ophiotaenia,* probably *O. amphiumae.* This form was described by Zelliff in 1932 from *Amphiuma means* and *Amphiuma tridactylum.* Riser, 1942, transferred the species to the genus *Ophiotaenia.*—All the tapeworms seem to be somewhat at variance with the original description. —The difference may be accounted for on the basis on host."

Investigation of the stomach contents proved an isopod, *Lyrceus happinae* (Faxon) to be the dominant food of the larval salamanders. Since this isopod appeared to be not only the most abundant animal in the cave but also the only crustacean, other than *Cambarus,* it is possible that *L. happinae* may be the secondary host.

ILLINOIS NATURAL HISTORY SURVEY, URBANA, ILLINOIS

The Lizards of Georgia

By WILFRED T. NEILL

The following article is based on material in my private collection and on notes accumulated since 1932. Collecting has been done in all of Georgia's 159 counties, and great numbers of locality records have been obtained. In the case of the commoner species I have listed only sufficient localities to define the range within the state. Notes on habits and habitats are based on personal observation in Georgia, except as otherwise indicated. Hibernation records for most of the forms have been discussed previously (Herpetologica, in press). The present article is an attempt to report new information; no effort has been made to compile published observations or records.

Anolis carolinensis Voigt. Rabun Co.: Clayton; Bartow Co.: Cartersville; Fulton Co.: Atlanta; Clarke Co.: Athens; Richmond Co.: Augusta; Bibb Co.: Macon; Bulloch Co.: Statesboro; Chatham Co.: Savannah; Calhoun Co.: Morgan; Charlton Co.: Moniac.

The pronounced metachrosis of the species has often been discussed. Courting, fighting, or foraging examples are bright green, but turn brown when pursued. Hibernating anoles are very dark brown. Sickly, emaciated examples are yellowish in summer, blue-gray in winter. Old males, when angered, not only expand the gular fan but also raise a conspicuous nuchal crest. It is astonishing that this habit was not described until 1940 (Ellis, 1940, Copeia 3: 162).

Many specimens from Augusta are parasitized by an insect larva, which develops within the lizard and, when ready to pupate, bores a hole through the reptile's digestive tract and body wall. The insect pupates within the anole and then drops out through the hole to the ground. Most "chameleons" recover from the experience.

Sceloporus undulatus undulatus (Latreille). Burke Co.: Keysville; Jenkins Co.: Millen; Chatham Co.: Savannah; Berrien Co.: Alapaha; Crisp Co.: Cordele.

Sceloporus undulatus hyacinthinus (Green). Rabun Co.: Tiger; Floyd Co.: Rome; Clarke Co.: Whitehall; Taliaferro Co.: Crawfordville; Monroe Co.: Forsyth; Richmond Co.: Augusta.

The above records indicate that Smith was right in his surmise that the Fall Line constituted the boundary between the two eastern races of *Sceloporus undulatus* (1946, Handbook of Lizards: 216). Typical *undulatus* from Keysville are the largest *Sceloporus* I have seen from Georgia. The two races do not differ markedly in habits. In general, *S. u. hyacinthinus* is more often seen on the ground, about rotting stumps, or on fallen timber; while *S. u. undulatus* is more frequently noted basking in the sunlight on vertical tree-trunks. The typical race is often found in moist or even swampy woods, often near the margins of streams and lakes; whereas *hyacinthinus* is most frequently found in pine woods or on dry hillsides. The Piedmont form seems more common, judging from the number of specimens collected. Both subspecies are usually infested with the "red bug" or chigger.

Phrynosoma cornutum (Harlan). The "horned toad" is found from time to time in Georgia. After the Texas Centennial, in particular, many of these lizards turned up in unexpected places, doubtless having been released by tourists who had purchased them for "souvenirs." I have seen one specimen from Atlanta and three from Augusta. There is no evidence to indicate the establishment of the form in Georgia.

Ophisaurus ventralis (Linnaeus). The "glass-snakes" of the islands off the Georgia (and South Carolina) coast differ widely from inland specimens. The scalation of the head is unusual in insular examples, there being two frontonasals, one anterior to the other, and two supralabials bordering the orbit below. The loreals are in two rows. The head is long and narrow, the body slender and somewhat compressed. The tail, when complete, is very long and thin, and the median subcaudals are often longer than wide. The dorsum is bronze, the sides and venter pale straw color. The two shades are separated by a sharply defined black line that begins a short distance behind the head and extends well on to the tail. The dorsal stripe is indistinct on juveniles, lacking on adults. The dorsum becomes darker in old examples, but the lateral stripe remains evident except on the head and neck, where it breaks up into spots. In contrast, inland specimens have one frontonasal and three rows of loreals. The eye is separated from the supralabials by suboculars and lorilabials. The head is proportionately broader, the body stouter and flatter, and the tail, when complete, shorter and stouter. The subcaudals are proportionately wider. Juveniles are striped laterally, but the stripe is not so thin and sharply defined as in the island type. The lateral stripe breaks up into spots and tessellations on most adults. A dorsal stripe is frequently present, particularly in smaller examples.

The insular form was described by Cope under the name of *Ophisaurus ventralis compressus* (1900: Ann. Rep. U. S. Nat. Mus., 1898: 501; type USNM No. 21359, from South Island, Georgetown County, South Carolina; collected by E. P. Alexander). The subspecies appears to be a valid one, and to it should be referred those "glass-snakes" from the islands off the coast of Georgia and South Carolina, at least from the type locality southward through McIntosh County, Georgia. On the mainland, *compressus* characters are soon submerged in the general population of *O. ventralis,* although a series from Bluffton, Beaufort County, South Carolina, seem referable to Cope's race.

Cope based his form on but one specimen, and in consequence certain of his diagnostic features do not hold. Thus the body is somewhat compressed as compared with inland examples, but the dorsal surface could scarcely be described as "narrow roof-shaped" in my specimens. The type probably was much emaciated at the time of preservation. Further, the scales are keeled, at least in smaller examples. Specimens from Wolf Island and Rock Island, McIntosh County, Georgia, do not have the prefrontals in broad contact. One Wolf Island "glass-snake" has a row of tiny suboculars. Juveniles are bronze above, straw color below, and the sharply defined black lateral stripe extends anteriorly almost or completely

to the head. In some juveniles from McIntosh County there is an indistinct vertebral stripe of light brown.

A young *Ophisaurus* from Rock Island, with complete and unregenerated tail, gave the following measurements (in mm.): body length 109; tail length 342; head length 17; head width 7; body width 8. In contrast, an inland specimen of nearly similar body length, from Augusta, Richmond County, also with complete and unregenerated tail, gave these figures: body length 100; tail length 259; head length 14; head width 10; body width 9. The figures are typical of insular and mainland specimens respectively, and well illustrate the differences in proportions between the two races.

Cope stated that he would have regarded *compressus* as a very distinct species from *ventralis,* were it not for the existence of USNM No. 10584, from Clearwater, Florida. This specimen combined typical *ventralis* form and scalation with a *compressus* coloration. The example is probably not an intergrade, but may indicate a development paralleling that of *compressus* along the beaches of western Florida. However, my Rock Island and Wolf Island series resemble typical *ventralis* a bit more than does Cope's type. Two young "glass-snakes" from Bluffton, Beaufort County, South Carolina, are characterized by a very tiny anterior frontonasal and by considerable anterior tessellation. On the whole I believe trinomials are warranted, although the two forms are very different in head shape, scalation, and proportions. The mainland population may still be composite, as suggested by Smith (*op. cit.*: 470). Further studies are obviously to be desired.

The insular subspecies is unusual in habits and choice of habitat. It is often astonishingly abundant, and sometimes appears to be the only species of reptile present. I have found this form only on beaches, where it prowls about the tidal wrack in the early morning. It is particularly common about the thick piles of palmetto leaves that are cast up by the waves. I have frequently lifted a handful of dead fronds and noted three or four "glass-snakes" and dozens of ucid crabs scurrying off in all directions.

Ophisaurus ventralis compressus Cope is known from the following localities: SOUTH CAROLINA—Georgetown Co.: South Island; Beaufort Co.: Hilton Head Island, Bluffton. GEORGIA—McIntosh Co.: Wolf Island, Rock Island.

Ophisaurus ventralis ventralis (Linnaeus), as herein restricted, has been noted at the following localities in Georgia: DeKalb Co.: Stone Mountain; Clarke Co.: Athens; Richmond Co.: Augusta; Taliaferro Co.: Crawfordville; Worth Co.: Sylvester; Effingham Co.: Pineora.

Carr stated that this form was often observed sunning in the open (1940; Univ. Fla. Pub. 3, no. 1: 74), but some other authors have taken exception to this statement. In Georgia the species is often seen basking in the sunlight beside a woodland trail or, more frequently, in a grassy field. A sunning individual is quick to detect the approach of an intruder, and will disappear in a flash among the grass-roots.

My largest specimens are from the Piedmont. One such, taken at Athens, measured 320 mm. in snout-to-vent length. A good bit of the tail had been lost and a small stub regenerated, but in spite of this deformity the total length was 825 mm.

Cnemidophorus sexlineatus (Linnaeus). Rabun Co.: Clayton; Clarke Co.: Athens; Floyd Co.: Rome; Hancock Co.: Sparta; Muscogee Co.: Columbus; Richmond Co.: Augusta; Bulloch Co.: Statesboro; Long Co.: Ludowici; Charlton Co.: Moniac.

I have records for almost every county in the state. Smith's discussion of the habits of this form is quite applicable to Georgia specimens (*op. cit.*: 415).

Leiolopisma laterale (Say). I have collected the species in almost every county, and feel sure that it occurs in the remainder. Many Augusta specimens are richly colored, the dorsum being bronze, the tail reddish, and the venter deep yellow.

Eumeces anthracinus anthracinus (Baird). One specimen has been reported from Wilson Gap, Rabun County (McCauley, 1940; Copeia 1: 50). A young naturalist showed me two examples he had collected at a locality between Tiger and Wylie, Rabun County. These specimens were not examined closely; subspecific allocation has been made on the basis of range, following Smith (1946; Univ. Kansas Pub. 1, no. 2: 87).

Eumeces egregius (Baird). This lizard has long been known as an inhabitant of Florida and adjacent parts of Charlton County, Georgia. In 1940 I noted two small colonies of the species much farther north, in Richmond County, Georgia (Copeia 4: 266). Since then I have located several other scattered populations in Richmond and Burke Counties. No specimen has been found in near-by South Carolina.

The habitat of the species in the Coastal Plain is a restricted one, consisting of arid, sandy wastes overgrown with broom-sedge and witchgrass. Throughout most of the year this skink remains below ground in small, ramifying burrows. Almost all specimens were found in March or early April, during the first definitely warm spells of Spring. At this time the lizards may be discovered under rocks, bark scraps, or boards, beneath which their tunnels open. Several specimens are usually found beneath one bit of cover. When disclosed, they are very active, attempting to escape down the burrows. An occasional example is seen abroad during the summer months. In most individuals part of the tail has been lost and subsequently regenerated.

Eumeces fasciatus (Linnaeus). Rabun Co.: Wylie; Jackson Co.: Attica; Henry Co.: Locust Grove; Bibb Co.: Macon; Richmond Co.: Augusta; Burke Co.: Midville; Dougherty Co.: Albany.

Eumeces inexpectatus Taylor. Fulton Co.: Buckhead; Clarke Co.: Athens; Taliaferro Co.: Crawfordville; Richmond Co.: Augusta; Bulloch Co.: Statesboro; Charlton Co.: Folkston.

Eumeces laticeps (Schneider). Fulton Co.: Buckhead; Clarke Co.: Athens; McDuffie Co.: Thomson; Richmond Co.: Augusta; Jenkins Co.: Rogers; Appling Co.: Baxley; Chatham Co.: Savannah.

E. fasciatus is commonest in the Piedmont but is also found in diminishing numbers well into the lower Coastal Plain. Locality records of *E. inexpectatus,* as mapped by Smith, fall into two disconnected groups (Handbook of Lizards: 503). The hiatus is probably due to incomplete collecting. The species ranges through the Piedmont and Coastal Plain of Georgia from the Savannah River to the Chattahoochee. It is more common in the Coastal Plain. *E. laticeps* is common below the Fall Line, somewhat less so above it. I have not found it above 1000 feet in Georgia.

The three species are readily distinguishable at all ages. The young of *inexpectatus* are very different from those of the other two forms. The dorsum of a juvenile *inexpectatus* is sooty black, and the light lines are very narrow, often being reduced to a series of disconnected dots. The median line is usually separated from the head lines. The tail is a dark blue, becoming almost violet distally. The abdomen is suffused posteriorly with black. The legs of the newly hatched young are completely black in some Coastal Plain localities. The head lines and upper labials are red at the time of hatching. In some Florida juveniles the entire venter is blackish and the tail is a deep blue-violet. Color differences between the three species are evident at all ages, but are often lost upon preservation.

Cope applied the name *Eumeces polygrammus* to a specimen from Colonel's Island, Liberty County, Georgia (1900; Ann. Rept. U.S. Nat. Mus. 1898: 637; type USNM No. 4156, collected by Dr. Jones). His description seems to point rather definitely to *inexpectatus,* as Taylor has indicated (Univ. Kansas Sci. Bull. 23: 231). However, the type has been lost, and one can not be sure of the identity of this form, which Cope first listed as a "variety" and then hesitantly relegated to the synonymy of *"E. quinquelineatus."*

E. inexpectatus is frequently observed basking in the sunlight on tree trunks. Juveniles of this form rarely climb trees, however, preferring to hide beneath logs or bark scraps when pursued. Adults often forage on the ground, but dash for the nearest tree when disturbed, usually climbing to a considerable height before halting. I have often noted these lizards crawling about on walls or the sides of buildings in bright sunlight. They progress with rapid, erratic movements, frequently changing direction, repeatedly extruding the tongue and pausing occasionally to snap at some tiny insect. This species, although occurring in moist or even swampy woods, is also found in very dry pine forests where the other forms are generally lacking.

Female *Eumeces* are known to brood their eggs in nests beneath the bark of rotting logs. On several occasions I have found two female *E. fasciatus* in the same nest, guarding clutches of from 15 to 24 eggs. Such large clutches could scarcely have been produced by one lizard, and the inference of communal nesting is obvious. The habit is surprising, since Noble and Mason found that a brooding *E. fasciatus* chased away others of its species (1933; Amer. Mus. Nov. 619: 18). However, communal

nesting has been noted or inferred in Old World gekkonids and scincids, and might be more common than is suspected in American forms.

A large male *E. laticeps* has been noted to defend itself by seizing an offending object or creature in its jaws and then twisting over and over, in much the same fashion as do crocodilians. One captive specimen thus killed an English sparrow that had been placed in the same cage with it.

DEPARTMENT OF BIOLOGY, AUGUSTA JUNIOR COLLEGE,
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Spiders Preying on Reptiles and Amphibians

By WILFRED T. NEILL

The "black widow" spider, *Latrodectes mactans,* is one of the commonest arachnids in Georgia. It is frequently encountered about logs or boards in fields, meadows, and edificarian situations. On two occasions I have found the desiccated remains of *Leiolopisma laterale,* entangled in the web of this spider. The reptiles had evidently been treated like small insect prey. A few years ago, when the "black widow" was receiving a great deal of newspaper publicity, there appeared several stories of "Spider Eats Snake." Accompanying photographs revealed *Latrodectes* preying upon *Opheodrys vernalis* and *Storeria dekayi.* This widespread and voracious arachnid might be an important factor in the ecology of small, cryptozoic reptiles.

Near Augusta, Richmond County, Georgia, I once found a large lycosid spider carrying in its jaws a newly metamorphosed *Rana clamitans.* The frog's limbs dangled loosely as though paralyzed. The frog was capable of emitting a series of attenuated yelps, however, and it was this "distress call" that had attracted my attenion. When disurbed, the spider ran agilely off into the grass, dragging its relatively bulky prey.

Many species of predacious spiders are common about stream margins, and may account for a goodly number of small amphibians. Goin has recorded the water spider *Dolomedes* killing *Acris gryllus* (1943, Proc. Fla. Acad. Sci. 6: 148). However, these same spiders are often eaten by larger frogs, and are preyed upon extensively by salamanders of the genus *Pseudotriton.*

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A New Lizard of the Genus *Emoia* From the Solomon Islands

By WALTER C. BROWN

Recently while examining a number of scincid lizards from the Solomons and other western Pacific islands in the collections at the Museum of Comparative Zoology at Harvard University, it was observed that the series of eleven specimens from San Cristobal Island, noted by Barbour (1921, p. 103) as differing from *Emoia nigra* in color pattern, actually represent an apparently undescribed species. Mr. Arthur Loveridge of that institution, with his usual kind generosity, suggested that I describe it. Since that time three additional specimens have been found in the collections of the Museum of Vertebrate Zoology at the University of California.

It is a pleasure to be able to associate with this new form the name of Dr. William Montana Mann, now Director of the National Zoological Park, Washington, D.C., who in 1916 made extensive collections in the southern islands of this group.

Emoia manni n. sp.

Type.—Museum of Comparative Zoology, No. 15078, adult female, collected by W. M. Mann at Wainone Bay, San Cristobal Island, Solomon Islands, 1916.

Paratypes.—Museum of Comparative Zoology, Nos. 15073-77 and 15079-83, all adults, collected with the type; Museum of Vertebrate Zoology at University of California, Nos. 44203 and 44230, near mouth of the Lunga River, Guadalcanal Island, collected by J. Chartin, July, 1944, and No. 44964, Munda, New Georgia Island, collected by Chas G. Sibley, Nov., 1944.

Diagnosis.—A moderately slender *Emoia* of the *atrocostata* group; differing from *atrocostata* in the posteriorly straight edged rostral, the greater length of the head and neck compared to the axilla to groin measurement (the latter measurement being 1+ to 1 1/6 times the distance from the snout to the forelimb as compared to 1 1/5 to 1 1/3 for *atrocostata*), and the darker coloration and color pattern; from *flavigularis* and *nigra* in the more slender pointed snout, the deep, posteriorly straight-edged rostral, the almost equal lengths of the mental and postmental (in *nigra* and the only specimen of *flavigularis* which I have seen the mental is much shorter than the postmental), the much smaller ear opening compared to the palpebral disc, the greater distance of the nostril from the tip of the snout, and the color pattern. The interparietal is long and narrow in contrast to the short interparietal of *nigra* and the absence of this shield in *flavigularis*.

Description.—Body moderately slender; head long; snout narrow and pointed. Rostral deep and straight edged posteriorly, forming a suture with the frontonasal; frontonasal nearly as long as broad; supranasal and postnasal present, nostril in the nasal; anterior loreal almost as long as the posterior, in contact with the first three upper labials. Prefrontals large but not in contact; frontal acutely narrowed posteriorly, longer than the supraoculars are broad at their widest point, and also longer than the fused frontoparietals. Supraoculars 4 on the right side, 5 on the left, followed by a small shield posteriorly on either side, the first broadly in contact with the prefrontal; 6 or 7 supraciliaries. Upper labials 8; lower labials 6; mental deep, almost completely separating the parietals. Interparietal distinct, long and narrow; a single pair of large nuchals. Midbody scalerows 38; lamellae under the fourth toe 36. Preanals slightly enlarged.

Color.—The dorsum (in preservation) grayish or slate-blue (Blue Haze, Pl. 38-C-4, Maerz and Paul, 1930), being more tan or russet (Cochin, Pl. 7-A-12), on the head and tail, with 10 or 11 very irregular, somewhat broken and indistinct

transverse dark brown (Ibis Red, Pl. 8-A-6) bands between the hind and the fore limbs. These brown bands tend to fuse in the dorsolateral region, but the lower lateral surfaces are marked as the dorsum. The limbs are predominantly brown, spotted or barred with slate-blue. The labials are rather reddish-tan suffused with slate as is the dorsal surface of the head. The venter is slate anteriorly, suffused with some tan or pale russet especially on the chin and pectoral region; posteriorly grayish-white (Grey Stone, Pl. 13-A-2) to light slate.

Measurements.—Length of head and body 61 mm., tail 107 mm., tip of snout to fore limb 26 mm., axilla to groin 28 mm., fore limb 23 mm., hind limb 34 mm.

Variation.—In this series of 14 adults the number of midbody scalerows varies from 37 to 41; the number of lamellae under the fourth toe from 36 to 40; upper labials from 7 to 9; lower labials from 6 to 8. The interparietal is generally distinct but may be partly fused with surrounding scales. The smallest specimen (M.C.Z. 15083) measures 63 mm., length of head and body; and the largest (M.C.Z. 15077) 75 mm. The dorsal color may be predominantly slate-blue, spotted or barred with brown toward the midline; the dorsal surface of the head may be quite dark reddish-brown; the venter yellow-white to pale russet-flesh (Woodland Rose, Pl. 4-A-10) suffused or darkened with slate anteriorly.

Remarks.—This form has been consistently confused with *nigra* from which it may be separated as follows:

Ear opening small, diameter less than, to equal to length of palpebral disc; rostral deep, posterior edge a straight line or nearly so.....*manni*

Ear opening large, diameter much greater than length of palpebral disc; rostral narrower, posterior edges forming an obtuse median angle, rounded or truncate at tip.....*nigra*

In the shape of the rostral this species most closely resembles so-called *atrocostata* from the Philippines (Taylor, 1923, pp. 226-28, fig. 39) but both rostral and mental are much deeper.

Literature Cited

Barbour, Thomas. 1921. Reptiles and amphibians from the British Solomon Islands. Proc. New England Zool. Club, 7: 91-112, pls. 2-6.

Maerz, A., and M. Rae Paul. 1930. A dictionary of color. McGraw-Hill Book Co., New York.

Schmidt, Karl P. 1932. Reptiles and amphibians from the Solomon Islands. Zool. series, Field Mus. Nat. Hist., Chicago, 18, 9: 175-190, pl. 8.

Taylor, Edward H. 1922. The lizards of the Philippine Islands. Philippine Bur. Sci. Pub., No. 17: 1-269, pls. 1-23.

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